CHAPTER 16

SITE RESTORATION PROCEDURES

16-1. General. This chapter identifies procedures and sources of information you will find helpful when selecting the appropriate corrective action for a particular UST site. Both soil and water contamination are addressed using in-situ and ex-situ remediation options. Contact the facility coordinator to determine unique site-specific requirements.

16-2. Soil Remediation Processes. Studies in the literature use different nomenclature to describe remediation methods. A recent EPA study classified the primary technologies into five categories.

a. In-Situ Treatment. In-situ treatment includes technologies such as vapor extraction, volatilization, air/vacuum extraction, in-situ soil venting, in-situ bioremediation, isolation/containment, and passive remediation.

b. Landfilling. This method includes all options using landfill disposal.

c. Land Treatment. Land treatment includes landfarming, ex-situ bioremediation, land application, land spreading, passive aeration, aeration, and ex-situ soil venting.

d. Thermal Treatment. Thermal treatment includes incineration, low-temperature thermal stripping, and treatment in asphalt plants.

e. Other. This category encompasses all other technologies such as soil washing, solidification/stabilization, or other technologies that do not fit into the other categories listed.

f. Selected references are as follows:

(1) Pope and Matthews. *Bioremediation Using the Land Treatment Concept*, EPA 600/R-93/164. August 1993.

(2) *Bioventing Performance and Cost Summary*. Air Force Center for Environmental Excellence. July 1994.

(3) *Guide for Conducting Treatability Studies Under CERCLA: Biodegradation Remedy Selection*, EPA/540/R-93/519a. August 1994.

(4) “Quick Reference Fact Sheet.” *Guide for Conducting Treatability Studies Under CERCLA: Biodegradation Remedy Selection*, EPA/540/R-93/519b. August 1994.

(5) Leeson, A. and Hinchee, R.E., et al. “Principles and Practices of Bioventing.” *Volume 1: Bioventing Principles* EPA/540/R-95/534a Columbus: Battelle Memorial Institute.

(6) Leeson, A. and Hinchee, R.E., et al. “Principles and Practices of Bioventing.” *Volume 2: Bioventing Design* EPA/540/R-95/534b. Columbus: Battelle Memorial Institute.

(7) *Technologies and Options for UST Corrective Actions: Overview of Current Practice*, EPA/542/R-92/010. August 1992.

(8) *U. S. Air Force Remediation Handbook for POL-Contaminated Sites*, U. S. Air Force. December 1993.

(9) Soil Vapor Extraction and Bioventing, EM 1110-1-4001.

g. Survey of Remediation Practices. The findings from a 1992 22-state survey (EPA/542/R-92/010) of petroleum-contaminated soil treatment/disposal practices revealed landfilling as the primary corrective action method used at 55 percent of the sites surveyed, followed by in-situ treatment at 19 percent, thermal treatment at 13 percent, land treatment at 11 percent, and other technologies at 2 percent.

Thermal treatment using asphalt plants was used at 61 percent of the sites, followed by low-temperature thermal treatment at 39 percent and incineration at less than 1 percent of the sites.

Land treatment corrective action sites most often used aeration (50 percent), followed by land farming (36 percent), and land application (13 percent).

Approximately 37 percent of the corrective action sites reported required some sort of groundwater corrective action as well. Information addressing remediation of groundwater sources is included in paragraph 16-4.

16-3. Backfill. Begin backfilling only after authorization from the Environmental Coordinator or IA and after the excavation area contaminants are determined to be below the remediation concentrations. This authorization should be issued within 24 to 48 hours after excavating is complete to allow time for laboratory analysis of the soils. Some exceptions should be noted, such as IA regulations and proximity to residential areas or other areas with restricted access.

a. Methods. Individual site conditions will determine the methods of backfill. Some of the options are detailed below.

(1) Backfill clean holes (as determined by lab analyses) with clean fill.

(2) Leave potentially contaminated holes open until confirmation sampling results have been obtained.

(3) Backfill potentially contaminated holes with granular backfill while awaiting analytical results in areas where safety is a concern.

(4) Place polyethylene liner in contaminated holes prior to backfilling.

(5) Backfill all holes with granular backfill regardless of contamination.

(6) Leave heavily contaminated holes open. The IA and the Environmental Coordinator must be contacted to determine the best option for the site.

b. Backfill.

(1) Use backfill as specified in CEGS Section 02315-*Excavation, Filling, and Backfilling for Buildings* or Section 02316-*Excavation, Filling, and Backfilling for Utilities Systems*.

(2) Perform density tests by an approved commercial testing laboratory or by facilities furnished by the contractor.

(3) Determine moisture density relations in laboratory tests in accordance with ASTM D 1557, Method B, C, or D or ASTM D 3017.

(4) Determine field in-place density in accordance with ASTM D 1556, ASTM D 2167, or ASTM D 2922.

(5) Material. The source of backfill material must be determined to be free of contamination through chemical analysis prior to placement of clean fill in the excavated area.

(6) Exceptions. If the soil excavation sample results indicate the site is not remediated, yet the limits of practical excavation have been reached, place a 6-mil or heavier polyethylene sheeting in the hole prior to backfilling. This polyethylene

sheeting will allow clean backfill placed in the hole to remain free of contamination.

c. Grading. All areas disturbed by construction must be uniformly smooth graded. The finished surface should be reasonably smooth, compacted, free from irregular surface changes, and maintained free of trash. Prepare surface for seeding or asphalt/concrete as required and specified in applicable USACE guide specifications.

16-4. Groundwater Remediation Processes. This section presents corrective action technologies for the removal of free product and for remediation of petroleum-contaminated groundwater.

a. Free-Product Recovery. There are typically two approaches for recovery of free product: trench systems and wells. The choice is usually based on site specific conditions. After collection, the free product is separated from the groundwater and disposed of or recycled. The remaining petroleum-contaminated groundwater is treated using a variety of methods and discharged to a publicly owned treatment works (POTW) or discharged to the environment. Specific technologies include skimmers, oleophilic-hydrophobic separators, free-product recovery with water table depression, vapor extraction/groundwater extraction, dual phase (liquid and vapor) recovery, and oil-water separation. Whichever option is selected, a permit to discharge must be negotiated with the IA.

b. Groundwater Remediation. Groundwater remediation can be accomplished either in-situ or ex-situ depending on the site characteristics. In-situ methods are preferred, if possible, and include such methods as air sparging, intrinsic remediation, and introduction of oxygen or nutrients.

The second, more conventional ex-situ methods include conventional pump-and-treat processes such as granular activated carbon (GAC) and air stripping, which are easily mobilized and readily available from a variety of suppliers in close proximity to most sites. Many times air stripping and GAC are used together to prolong the life of the carbon. Other options for ex-situ treatment include ultraviolet oxidation, biological treatment, or simply discharging to a POTW.

c. Selected references are as follows:

(1) *Cleanup of Releases From Petroleum USTs: Selected Technologies*, EPA/530/UST-88/001. April, 1988.

(2) *Diagnostic Evaluation of In-Situ SVE-Based System Performance*, EPA/600/R-96/041, NTIS PB96-163537. March, 1996.

(3) *Engineer Design of Free-Product Recovery Systems*, EPA/600/R-96/031, NTIS PB96-153556. 1996.

(4) *How to Effectively Recover Free Product of Leaking UST Sites*, EPA/510/R-96/001. September, 1996.

(5) *In-situ Air Sparging*, EM 1110-1-4005

(6) *In-Situ Air Sparging: Evaluation of Petroleum Industry Sites and Considerations for Applicability, Design and Operation*, API Publication Number 4609. American Petroleum Institute. April, 1995.

(7) *In-Situ SVE-Based Systems for Free-Product Recovery and Residual Hydrocarbon Removal*, EPA/600/R-96/042, NTIS PB96-163605. 1996.

(8) *Remediation Technologies Screening Matrix and Reference Guide*, EPA/542/B-94/013, NTIS PB95-104782. October, 1994.

(9) Rifai, H.S. “Modeling Natural Attenuation Using Bioplume II/III Model,” Presentation at the U.S. Air Force Center for Environmental Excellence, Environmental Restoration Technology Transfer Symposium. November, 1994.

(10) *Standard Guide for Corrective Action for Petroleum Releases*, ASTM E 1599. 1994.

(11) *Standard Guide for Risk Based Corrective Action Applied at Petroleum Release Sites*, ASTM E 1739. 1995.

(12) *Test Plan and Technical Protocol for Bioslurping.* AFCEE, Technology Transfer Division. Draft copy. January 30, 1994.

(13) *Technical Protocol for Implementing the Intrinsic Remediation with Long-Term Monitoring Option for Natural Attenuation of Dissolved-Phase Fuel Contamination in Groundwater*. AFCEE. 1994.

(14) *Soil Bentonite Slurry Trench Cutoff*, Corps of Engineers Civil Works Guide Specification (CWGS) 02214.

(15) *Chemical Feed Systems*, Corps of Engineers Guide Specification (CEGS) 11242.

(16) *Water Softeners, Cation Exchange (Sodium Cycle)*, CEGS 11250.

(17) *Air Stripping Systems*, CEGS 11301.

(18) *Prefabricated Biochemical Wastewater Treatment Plant*, CEGS 11390.

(19) *Low Permeability Clay Layer*, CEGS 02377.

(20) *Soil-Bentonite Slurry Trench for HTRW Projects*, CEGS 02260.

(21) *Solidification/Stabilization of Contaminated Material*, CEGS 02160.

(22) *Groundwater Monitoring Wells*, CEGS 02522.

(23) *Piping; Off-Gas*, CEGS 02150.

(24) *Fans/Blowers/Pumps; Off-Gas*, CEGS 11215.

(25) *Downflow Liquid Activated Carbon Adsorption Units*, CEGS 11225.

(26) *Chemical Feed Systems*, CEGS 11242.

(27) *Air Stripping Systems*, CEGS 11301.

(28) *Plate and Frame Filter Press System*, CEGS 11360.

(29) *Filtration System*, CEGS 11393.

(30) *Vapor Phase Activated Carbon Adsorption Units*, CEGS 11226.

(31) *Advanced Oxidation Processes (AOP)*, CEGS 11377.

(32) *Thermal (Catalytic) Oxidation Unit*, CEGS 11378.

16-5. Waste Disposal. Disposal requirements are identified in Chapters 12 and 14.